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B29C 45/17 69/00

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(56) Documents Cited
GB 2217644 A GB 1391794 A

(58) Field of Search
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INT CL^6 B29C 45/17 69/00
Online:WPI

(54) Self-contained gas injector

(57) A gas assisted injection molding machine 10 comprises a clamping plate 12, a core 14, a cavity plate 18, a mould cavity 22 defined between core 14 and plate 18 and an injector valve assembly 30 secured to plate 12 and having an elongate supply duct 60 extending through core 14 and into cavity 22. The duct 60 supports a slidable valve member 66 which is biased by biasing means 76 to a closed position, in which a radial head of valve member 66 engages an end of duct 60, to inhibit injection of fluid into cavity 22 to mould an article. The duct 60 is supported in core 14 by an ejector sleeve which moves with an ejection mechanism 24 to to force moulded articles off the end of duct 60. Valve member 66 is slidably supported by engagement with walls defining duct 60 and is relieved at circumferentially spaced locations adjacent said walls to permit gas passage along duct 60. A base 40 of assembly 30 is accomodated on plate 12 requiring only relatively small diameter duct 60 to project through core 14. The assembly may be withdrawn from the rear of plate 12.

The assembly 30b may be arranged for duct 60 to project into cavity 22 from a side of cavity plate 18.

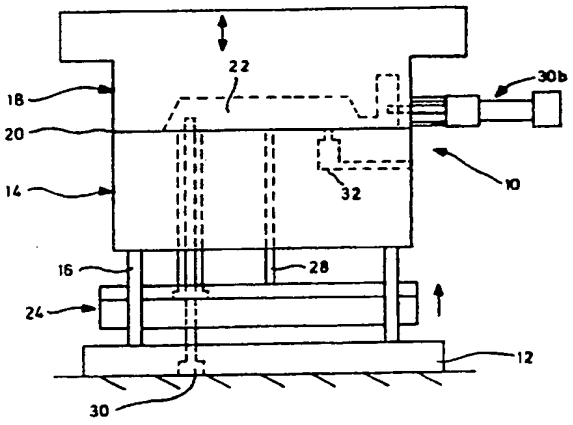

FIG. 1

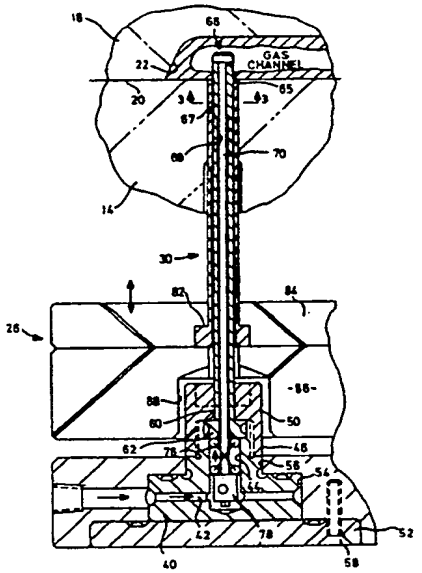

FIG. 2

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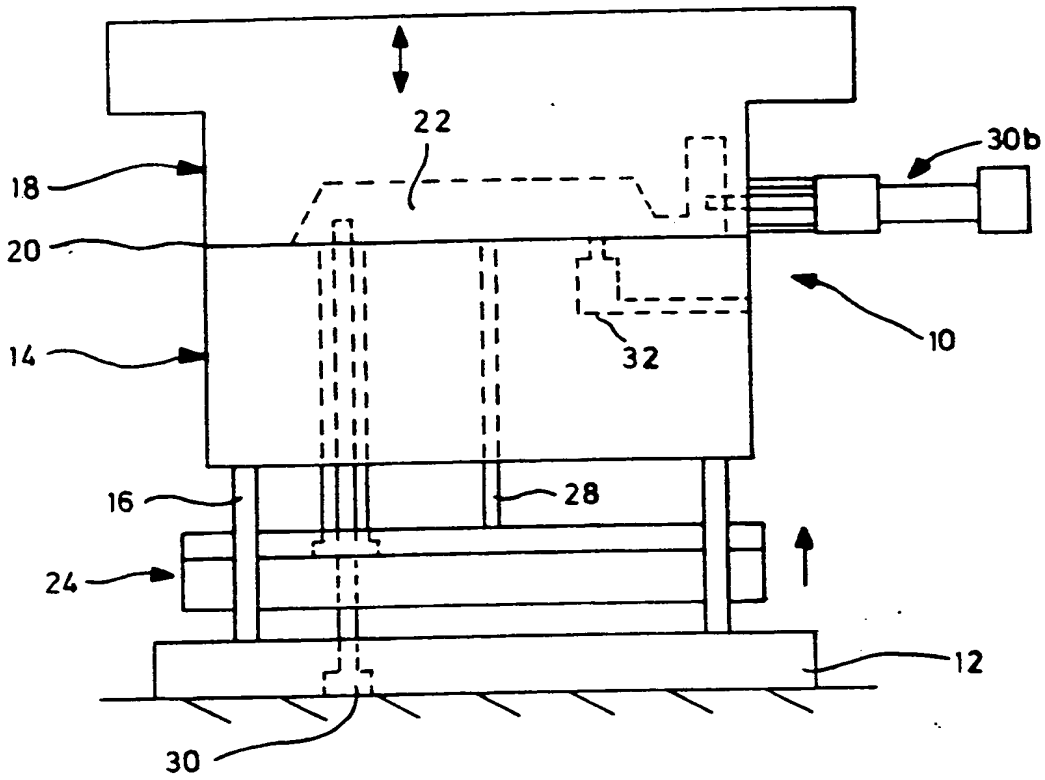
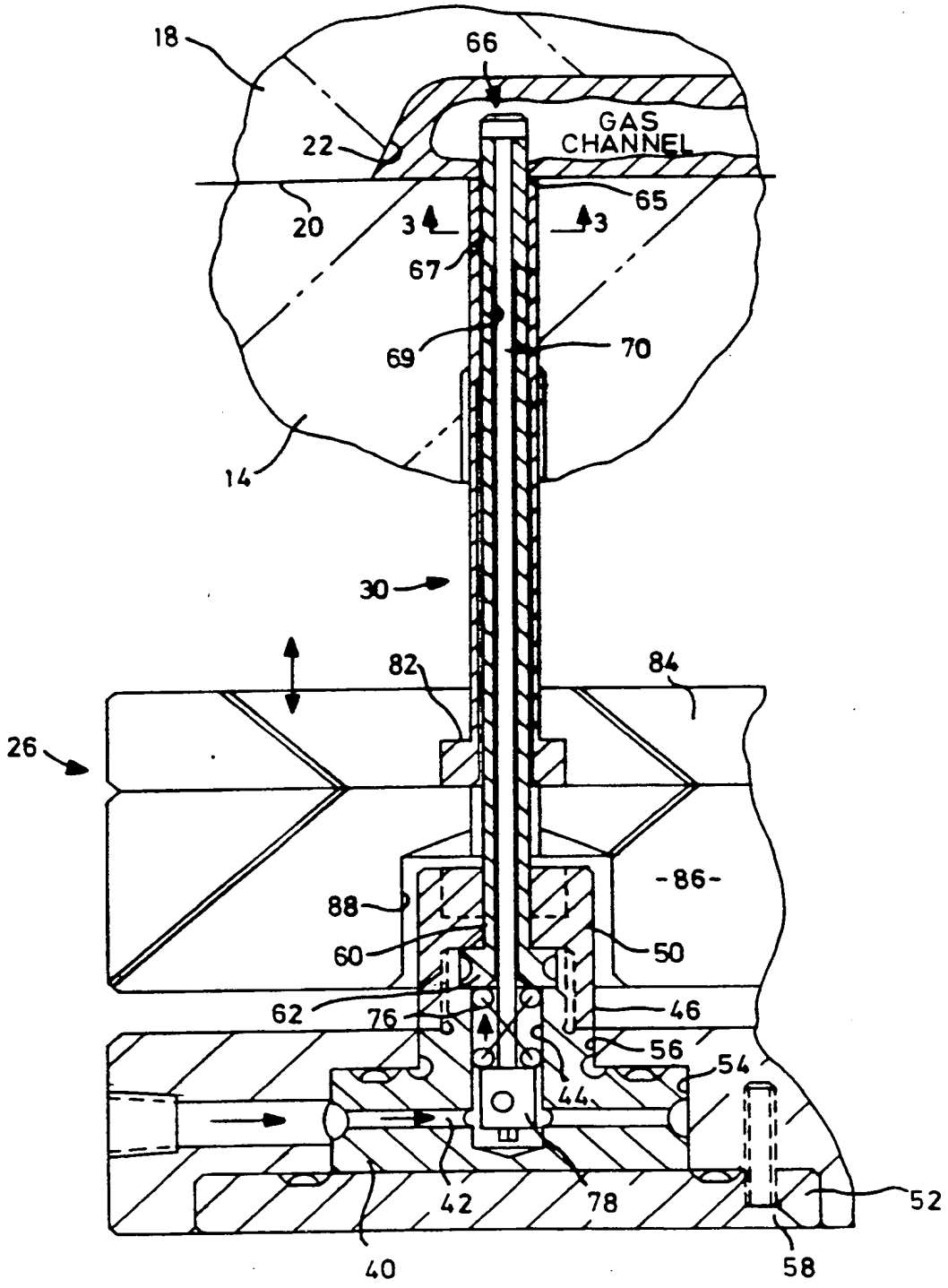


FIG. 1


18
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GAS
CHANNEL
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70
14
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FIG. 2

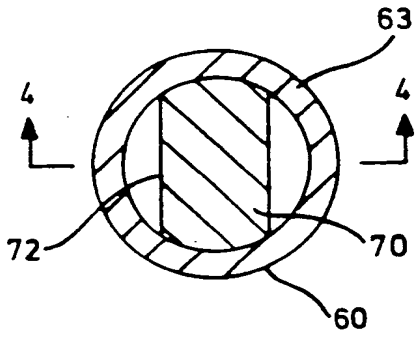

FIG. 3

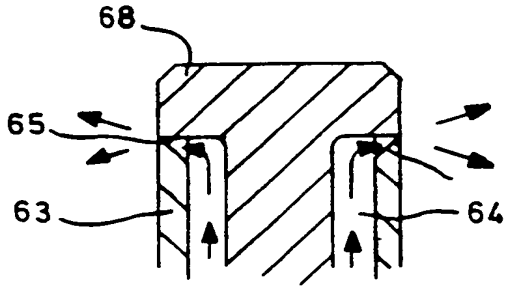

FIG. 4

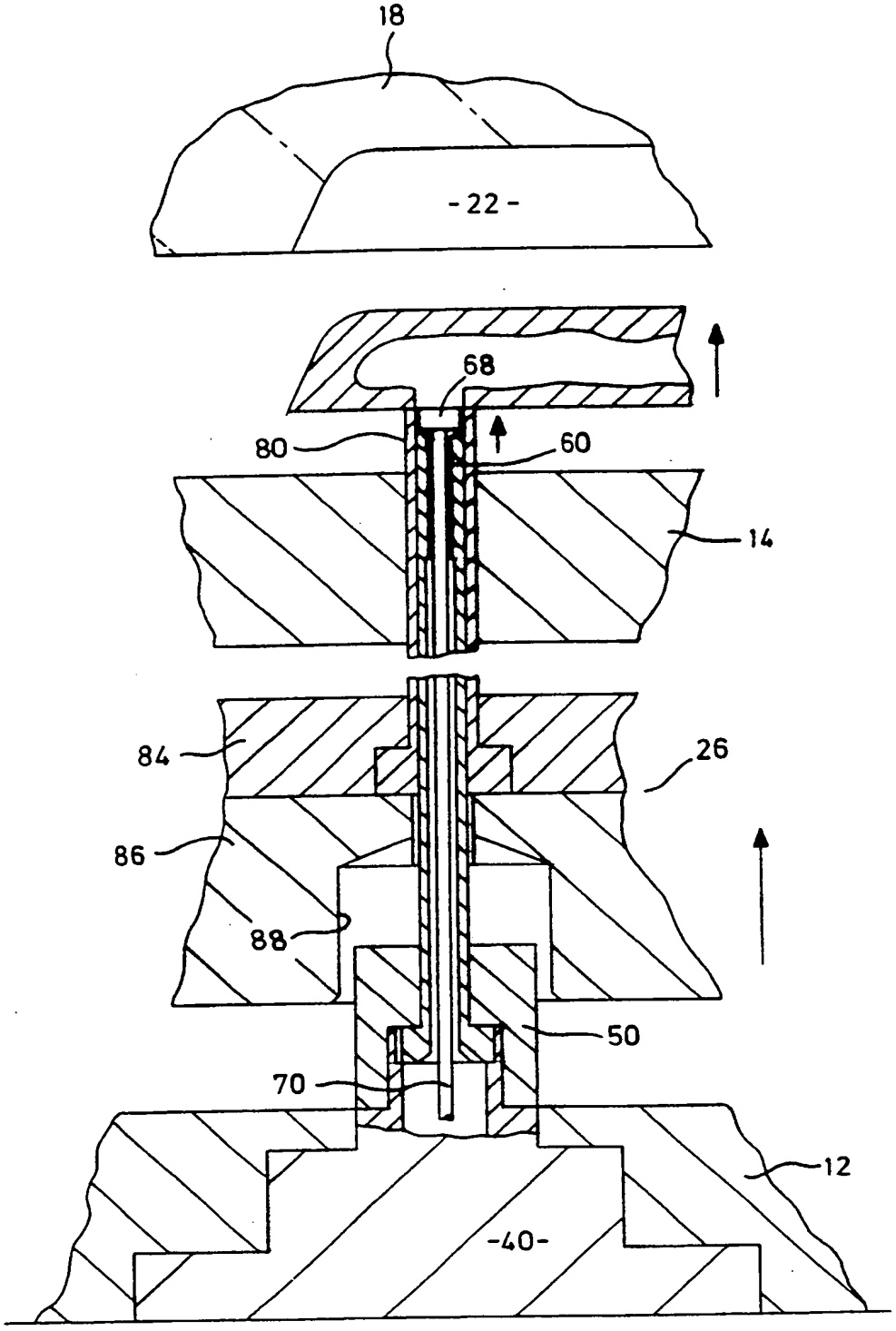

FIG. 5

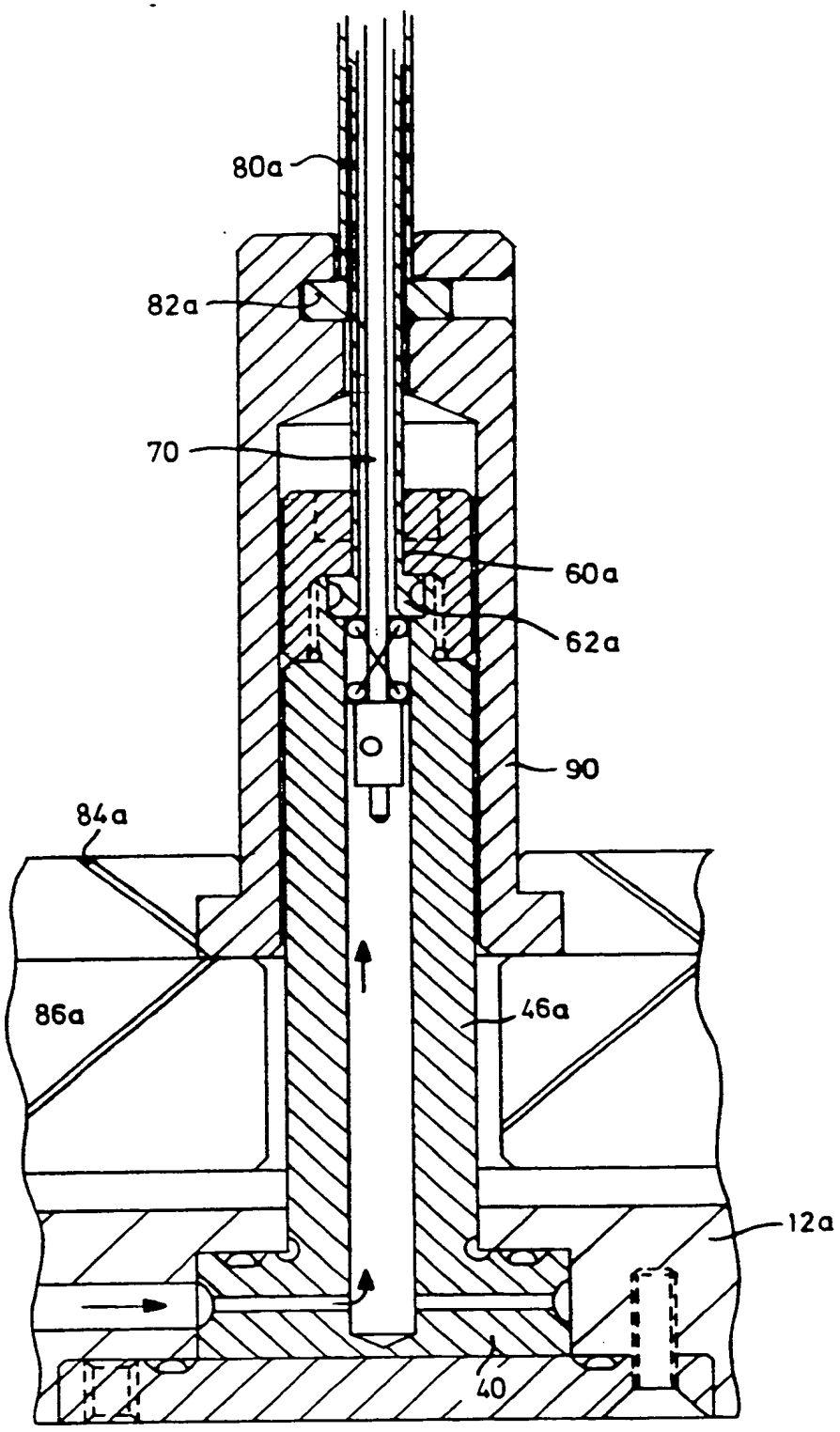

FIG. 6

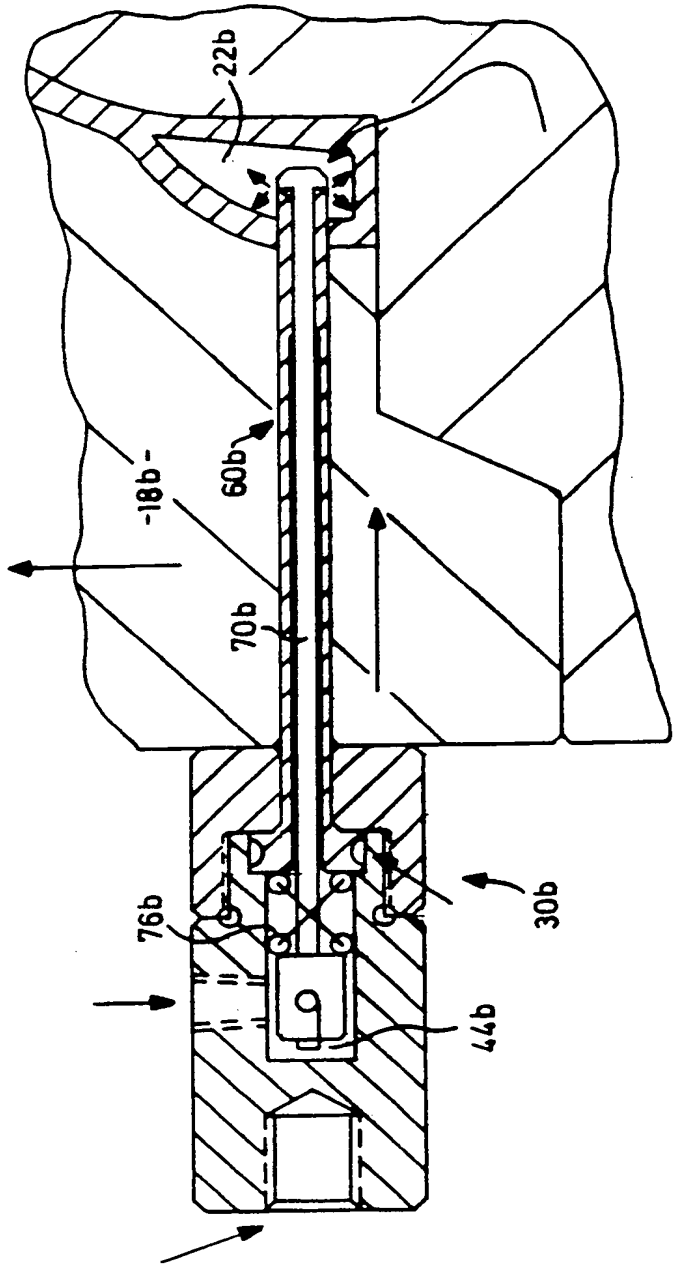

FIG. 7

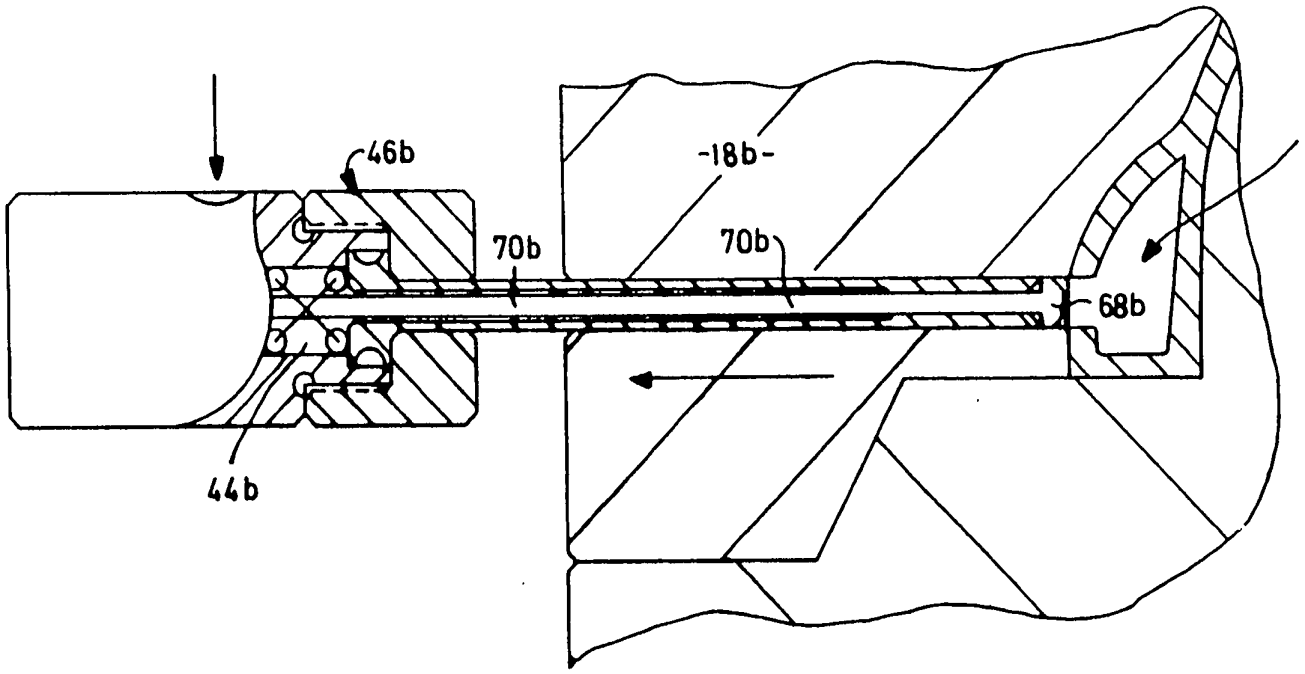

FIG. 8

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DESCRIPTION OF INVENTION

SELF-CONTAINED GAS INJECTOR

The present invention relates to gas-assisted injection molding machines and to injectors for use with such machines.

Gas-assisted injection molding is a well-known technique in which gas is injected into a mold after the molding material has been supplied to the mold cavity. As the gas is injected, the material within the interior of the cavity is expelled through a vent leaving a wall around the periphery of the cavity. In this way, a hollow article may be molded leading to significant reductions in weight and material.

Injection molding machines typically have a backing plate or clamping plate on which is mounted a core and a cavity plate. The core and cavity plate are separable along a common plane and the cavity is formed on the common plane so that upon opening of the mold, the molded article may be removed. Removal of the article is assisted by an ejector mechanism which typically includes pins movable normal to the common plane after the mold has opened so that the article is elevated from the core and may readily be removed.

The gas is injected by gas injectors that protrude into the cavity so as to inject the gas within the article to be molded. These are typically mounted directly on the core on the opposite surface to the mold cavity. In this arrangement, however, servicing of an injector becomes difficult as it is located between the core and the clamp plate and must also accomodate movement of the ejection mechanism. Accordingly, in order to service an injector, it is frequently necessary to disassemble the molding machine, which may weigh several hundred pounds, which results in significant cost and down time for the machine.

A further problem with existing designs is that the direct mounting of the injectors on the core requires a large cavity to accomodate the injectors. The size of the cavity significantly weakens the mold, particularly

where multiple channels are formed in the molded product requiring multiple injectors. The weakening of the mold of course adversely affects the quality of the molded product and may require local strengthening of the mold which further complicates the installation of the injector. As such, there is a need for a molding machine in which the installation of the injector is simplified.

These problems are exacerbated by existing designs of injectors which have a relatively large diameter of the injector body. This may be attributed to the nozzle design in which the operating components are located adjacent to the nozzle tip. The relatively large nozzle diameter creates a substantial void in the molded article and in practical terms limits the projection of the nozzle into the mold. This has a disadvantage in that the gas is injected into the cavity adjacent a wall which may cause breakout or imperfect molding of the article.

As such, therefore, there is a need to provide an injector nozzle which not only simplifies installation but also permits injection of the gas into the interior of the cavity.

It is therefore an object of the present invention to obviate or mitigate the above disadvantages.

In general terms, the present invention provides a gas-assisted injection molding machine in which an injection valve assembly has a body mounted on the clamping plate. A gas supply duct extends from the clamping plate through the core and into the cavity. In the preferred embodiment, the body is mounted on the opposite side of the clamping plate to the core to facilitate removal of the valve assembly. In this way, the valve assembly may be removed without disturbing the clamping plates and, because the operating components of the valve assembly may be located in the body, the apertures in the core are significantly reduced.

It is also preferred to locate the gas supply duct within a sleeve that is slidable relative to the core. The sleeve is connected to the ejector mechanism so that upon ejection of the molded component, the sleeve slides in the core and assists in pushing the component from the mold.

Embodiments of the present invention will now be described by way of example only with reference to the accompanying drawings, in which

Figure 1 is a schematic representation of an injection molding machine;

Figure 2 is a sectional view on an enlarged scale of a portion of the injection molding machine shown in Figure 1;

Figure 3 is a view on the line 3-3 of Figure 1;

Figure 4 is a view on the line 4-4 of Figure 3;

Figure 5 is a view similar to Figure 2 showing the assembly in an alternate position;

Figure 6 is a view similar to Figure 1 showing an alternate embodiment to accomodate the differently proportioned molding machines;

Figure 7 is a section on the line 7-7 of Figure 1 showing a further arrangement of gas injection valve; and

Figure 8 is a view similar to Figure 7 showing the components in an alternate configuration.

Referring therefore to Figure 1, an injection molding machine 10 includes a clamping plate or base plate 12 that may be secured to a suitable mounting structure (not shown). A core 14 is supported on the clamping plate 12 by a support structure 16 so as to be spaced from but fixed relative to the clamping member 12. A cavity plate 18 is mounted on the core 14 so as to be movable relative thereto between the closed position as shown in solid lines and an open position shown in chain dot lines in Figure 1. The core 14 and cavity plate 18

abut along a common plane of separation 20 in the closed position.

A mold cavity 22 is formed between the core 14 and the cavity 18 to define the exterior surface of an article to be molded. Typically, the core 14 will have a substantially planar surface defining the back of the article to be molded with contoured surfaces being formed in the cavity 18. More complicated shapes may of course be formed by having contoured surfaces formed in both the core 14 and the cavity plate 18.

An ejector mechanism 24 is located between the clamping plate 12 and core 14 and includes an injector plate assembly 26 slidably mounted on the support 16 for movement relative to the core 14. Ejector pins 28 are secured to the ejector plate assembly 26 and extend through the core 14 to terminate at the surface of the mold cavity 22.

With the cavity plate 18 in the open position, the ejector plate assembly 26 may be advanced toward the core 14 and cause the ejector pins 28 to engage the molded article and eject it from the core 14.

A gas injection valve assembly 30 is positioned in the core 14 to supply pressurized gas to the interior of the cavity 22. Gas will expel material from the cavity through a vent valve 32 and thereby permit a hollow article to be molded. Multiple voids may be formed in the article requiring a plurality of assemblies 30, some of which (as indicated at 30b) may be mounted on the side of the cavity plate 18.

The valve assembly 30 is seen in further detail in Figure 2. Referring therefore to Figure 2, the valve assembly 30 includes a manifold 31 having a circular base 40 with an internal passageway 42 aligned with a conduit 34 in the clamping plate 12 and communicating with a chamber 44. The chamber 44 extends into a cylindrical boss 46 formed on the base 40.

The base 40 of valve assembly 30 is located within a counterbore 54 provided in the opposite side of the clamping plate 12 to the core 14. A throughbore 56 extends from the counterbore 54 through the clamping plate 12 to snugly receive the protruding boss 46. Countersunk screws 48 secure a retaining plate 52 to the clamping plate 12 to hold the base 40 on the clamping plate 12.

An elongate supply duct 60 is secured to the boss 46 by means of a cap 50 that traps an integral shoulder 62 between the end 48 of boss 46 and the underside of cap 50. The duct 60 extends through the ejector plate assembly 24 and core 14 to project into the cavity 22 and is formed with a tubular wall 63 that defines an internal bore 64. Gas from the passage 42 may flow through chamber 44 and along the bore 64 into cavity 22.

A valve member 66 is slidably mounted within the bore 64 and as can best be seen in Figures 3 and 4, includes a cylindrical head 68 carried on an elongate needle 70. The head 68 extends radially over an end face 65 of the duct 60 to seal the internal conduit 64.

The inner surface of wall 63 includes a cylindrical portion 67 adjacent the end face 65 and a diametrically enlarged portion 69 on the balance of its length.

As shown in Figure 3, the needle 70 is generally cylindrical to conform to the inner surface of the cylindrical portion of wall 63 and has a pair of flats 72 formed to allow passage of gas along the bore 64. The needle 70 is radially spaced from the enlarged portion 60 to provide a continuous passageway from chamber 44 to the head 68.

As shown in Figure 4, a pair of inclined slots 74 are provided at diametrically opposed locations opposite the flats 72 to direct jets of gas generally radially into the cavity 22. The needle 70 is thus

slidable supported within the duct with its movement limited by abutment of the head 68 with the end face 65 of the duct. The head 68 is biased against the end face of the duct 60 by a spring 76 disposed about the needle within the chamber 44. The spring 76 acts against the underside of shoulder 62 and against a piston 78 secured to the needle 70.

The duct 60 is supported within the core 14 within an ejector sleeve 80 that it is slidably mounted within the core 14. The ejector sleeve 80 is provided with an enlarged flange 82 at its lower end that is trapped between an ejector retainer plate 84 and the ejector plate 86 that together form the ejector plate assembly 26. The ejector sleeve 80 is thus connected to the ejector plate assembly 24 to move with it through the core 14. The ejector plate 86 is also formed with a recess 88 that receives the boss 46 when the ejector plate assembly 24 is retracted.

At its upper end 89, the sleeve 80 is a close sliding fit on the outer surface of the duct 60 to provide support and to seal the duct 60 in the cavity 22. To reduce sliding friction, a radial clearance is provided between the duct 60 and sleeve 80 toward its lower end as it leaves the core 14.

In operation, the cavity plate 18 and core 14 abut in the closed position and molding material is introduced into the cavity 22. At this time, the ejector plate assembly 24 is retracted so that the upper end 89 of ejector sleeve 80 is flush through with the wall of the cavity defined by the plane of separation 20. The extreme end of supply duct 60 and head 68 of valve member 66 project upwardly from the separation plane into the cavity 22. Molding material is injected into the cavity 22 in a known manner and, once the cavity is full, pressurized gas is introduced through the conduit 34 provided in the clamping plate 12 to the internal duct 42.

The gas passes through the bore 64 of supply duct 60 and its pressure acting on head 68 and piston 78 lifts the valve member to move the head 68 away from the end face 65 of supply duct 60. The gas is thus injected into the interior of the cavity 22 and voids the material from the interior of the cavity 22 through the vent valve 32. A thin wall structure is left in the cavity to define the outer shape of the molded article.

Upon completion of the molding process, the pressure is removed from the chamber 44 and the head 68 returns into sealing engagement with the end face 65 of the duct 60 under the influence of the spring 76. The cavity plate 18 is then opened, leaving the molded article on the core 14. The ejector plate assembly 26 of ejector mechanism 24 is then advanced towards the core 14 causing the ejector pins 28 to engage the molded article. At the same time, the ejector sleeve 80 is advanced through the core 14 and pushes the molded article from the tubular wall 63 through the supply duct 60. As shown in Figure 5, the supply duct 60 is retained in situ on the clamping plate 12 and the sleeve 80 advanced until it is flush with the end of the supply duct 60 to release fully the molded article. The article is then removed and the cavity plate 18 returned to a closed position ready to mold the next article. The ejector mechanism 24 also returns plate assembly 26 to the retracted position, leaving the supply duct 60 protruding into the cavity.

It will be noted that the body 40, chamber 44 and boss 46 are accomodated on the clamping plate 12 requiring only the relatively small diameter supply duct 60 to project upwardly through the core 14. This arrangement reduces the size of the bore in the core that is necessary to accomodate the supply duct and also permits the relatively small diameter supply duct to project fully into the cavity. The hole formed in the molded article by the supply duct is sufficiently small not to affect the overall integrity of that article and

the positioning of the ejector sleeve 80 about the supply duct also facilitates removal of the molded article with minimum risk of damage to both the molded article and the duct.

If it becomes necessary to service the valve assembly 30, it is simply necessary to remove the retaining screws 58 and withdraw the valve assembly 30 from the rear of the clamping plate 12. The supply duct 60 may slide through the ejector sleeve 80, which is held in place by the ejector plate assembly 26, and which also serves as a guide to facilitate reinsertion of the valve assembly. The removal of the valve assembly therefore does not require disassembly of the molding machine 10.

In some mold designs, there is a significant distance between the clamping plate 12 and the core 14. As can be seen from Figure 6, the arrangement shown in Figure 2 can readily be modified to accomodate different heights of core 14. In the embodiment shown in Figure 6 where like components are identified with like numerals with a suffix "a" added for clarity, the boss 46a is elongated and the supply duct 60a supported at an elevated position relative to the clamping plate 12a. An extension member 90 is secured to the shoulder 82a of the ejector sleeve 80a and in turn is received and secured between the ejector retaining plate 84a and the ejector plate 86a. In this manner, the valve assembly 30a may be positioned adjacent to the underside of the core 14a to minimize the overall length of the needle 70a but at the same time the arrangement still permits extraction of the valve assembly 30a simply by removal of the securing screws 58.

The valve assembly 30 may also be utilized to provide voids within an article that can only be formed from the side of the cavity plate 18. Such an arrangement is shown in Figures 7 and 8 where similar components to those shown in Figures 1-5 are denoted by

like reference numerals with a suffix "b" added for clarity.

In the arrangement shown in Figures 7 and 8, the valve assembly 30b is secured to one end of a cylinder 92 indicated in Figure 1 which may advance and retract the valve assembly relative to the cavity plate 18b. In the advance position shown in Figure 7, the supply duct 60b extends into the cavity 22b to be effective to void the interior of the article. Once the material has been evacuated, the valve closes under the action of the spring 76b and the cylinder 92 retracts the supply duct 60b and needle as shown in Figure 8. With this arrangement, the molded article is supported about the supply duct 60b by the walls of the cavity plate 18b and thus ensures that the duct can be extracted from the article without damage.

Once retracted, the cavity plate 18 may be opened, carrying the cylinder and valve assembly 30b with it, and the article ejected without interference from the valve assembly 30b. Again, however, the location of the chamber 44b and spring 76b remote from the distal end of the needle permits a relatively small diameter supply duct to be utilized and therefore protrude into the interior of the cavity.

CLAIMS

1. A gas assisted injection molding machine comprising a clamping plate, a core supported on said clamping plate in spaced relation thereto, a cavity plate juxtaposed on said core and movable relative thereto between a closed position in which a mold cavity is defined between said core and said cavity plate and an open position to allow removal of a molded component from said cavity, an ejector mechanism movable relative to said core to eject molded components from said cavity and at least one gas injection valve assembly to inject gas into said mold cavity, characterized in that said valve assembly (30) has a manifold (31) mounted on said clamping plate (12) and having an internal passageway (42) connected to a source of pressurized gas (P), a supply duct (60) secured to said manifold (31) and extending from said passageway (42) into said cavity (22) and a valve member (66) slidably mounted in said duct (60) and having biasing means (76) to bias said valve member (66) to a closed position in which flow through said duct (60) is inhibited.

2. A molding machine according to claim 1 further characterized in that said manifold (31) is located on an opposite side of said clamping plate (12) to said core (14) and extends through an aperture (56) in said clamping plate (12) for connection to said supply duct (60).

3. A molding machine according to claim 2 further characterized in that said manifold (31) is located in a counterbore (54) in said clamping plate (12).

4. A molding machine according to claim 2 or 3 further characterized in that said manifold (31) includes

a boss (46) that projects through said clamping plate (12) and said supply duct (60) is connected thereto.

5. A molding machine according to claim 1 to 4 further characterized in that said supply duct (60) is supported in said core (14) within a sleeve (80) slidable relative to said core (14) and said duct (42) and connected to said ejector mechanism (24) for movement therewith.

6. A molding machine according to claim 5 further characterized in that said sleeve (80) has a distal end (89) that lies flush with a wall (20) of said mold cavity (22) when said ejector mechanism (24) is retracted.

7. A molding machine according to claim 6 further characterized in that said distal end (89) extends into said cavity (22) when said ejector mechanism (24) is extended to push a molded component off said supply duct (60).

8. A molding machine according to any preceding claim further characterized in that said valve member (66) includes a head (68) extending radially over an end of said supply duct (60).

9. A molding machine according to any preceding claim further characterized in that said valve member (66) includes an elongate needle (70) extending along said supply duct (66) toward said manifold (31).

10. A molding machine according to claim 9 further characterized in that said supply duct (42) and needle (70) terminate in a chamber (44) in said manifold (31) and said biasing means (76) is located in said chamber (44) to act between said supply duct (42) and needle (70).

11. A molding machine according to claim 10 further characterized in that said manifold (31) includes a body (40) and a boss extending from said body (40) and said chamber (44) is located within said boss (46).

12. A molding machine according to claim 11 further characterized in that said body (40) is located on an opposite side of said clamping plate (12) to said core (14) and said boss (46) extends through said clamping plate (12).

13. A molding machine according to claim 1 further characterized in that said manifold (31) includes a body (40) and a boss (46) upstanding from said body (40) with said valve member (66) being secured thereto, said body (40) being located on an opposite side of said clamping plate (12) to said core (14) and said boss (46) extending through a bore (56) in said clamping plate (12) whereby said injection valve assembly (30) may be removed from said core (14) by release of said body (40) from said clamping plate (12) and retraction of said boss (46) through said bore (56).

14. A molding machine according to claim 13 wherein said body (40) is located in a counterbore (54) in said clamping plate (12).

15. A gas injector valve assembly for injecting gas into a mold cavity of a gas assisted injection molding machine comprising a manifold having an internal passageway connectable to a supply of pressurized gas, a supply duct connected to said manifold, a valve member slidable in said supply duct and having a radial head extending across an end of said supply duct remote from said manifold and biasing means acting between an opposite end of said duct and said valve member to bias said head into engagement with said one end,

characterized in that said valve member (66) is slidably supported by engagement with walls (63) defining said duct (60) and said valve member (66) is relieved at circumferentially spaced locations (72) adjacent its engagement with said walls (63) to permit passage of gas along said duct (60).

16. A gas injector valve assembly according to claim 15 further characterized in that a plurality of notches (74) are formed in a wall (63) defining said duct adjacent said one end to direct gas radially from said duct.

17. A gas injector valve assembly according to claim 15 or 16 further characterized in that said manifold (31) includes a body (40) and a boss (46) upstanding from said body (40), said supply duct (60) including an elongate tubular wall (63) defining a conduit (64) for said gas and secured to said boss (46) to communicate with a chamber (44) therein, said chamber (44) being connected to said internal passageway (42).

18. A gas injector valve assembly according to claim 17 further characterized in that said valve member (66) extends through said conduit (64) and into said chamber (44).

19. A gas injector valve assembly according to claim 18 further characterized in that said biasing means (76) is located in said chamber (44).

20. Any novel feature or combination of features disclosed herein.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search rep rt)

Application number
GB 9502561.5

Relevant Technical Fields

(i) UK Cl (Ed.N) B5A (AT14B, AT14F, AT14G, AT14P, AT14S)

(ii) Int Cl (Ed.6) B29C 45/17, 69/00

Search Examiner
MR M SIDDIQUE

Date of completion of Search
18 MAY 1995

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE: WPI

Documents considered relevant following a search in respect of Claims :-
1-14

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
A	GB 2217644 A	(CINPRES) separate blow tube 26	1
A	GB 1391794	(JENKINS) plate 26 etc	1

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Jou (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).